

A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

MINDFULNESS & COGNITIVE PROCESSING

Examining the Link between a Brief Mindfulness Intervention and Cognitive Reflection.

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Abstract

This thesis examines the link between a brief mindfulness induction and cognitive reflection. It hypothesizes that a brief mindfulness induction increases task engagement, assessed by self-reported task focus and time taken on tasks. It further hypothesizes that a brief mindfulness induction increases performance on cognitive reflection tasks and that task engagement mediates that relationship. Results show no significant link between mindfulness and task engagement and no significant mediating effects. However, findings suggest a negative correlation between mindfulness and cognitive reflection task performance, which disconfirms the hypothesis. This contributes to the literature on the negative effects of mindfulness.

Keywords: cognitive reflection, state mindfulness, cognitive processing, task engagement

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Introduction

The increasingly fast-paced, constantly changing modern world, requires managers to take numerous complex decisions throughout the day. Those decisions can be based on deliberately collected and well-analyzed data or on simple intuition, delivering a quick and effortless first solution to a problem which has often revealed to be very effective (Gigerenzer 1996). Nevertheless, decision speed that makes intuition attractive at work (Khatri and Ng 2000), has its disadvantages as well. Intuition can induce people rushing into a decision and thus, lead to errors (Tversky and Kahneman 1973). To prevent this from happening, people are required to engage in deeper cognitive processing, also called cognitive reflection. However, intuition being much less effortful, people often prefer to irrationally rely on wrong intuitive impulses before engaging in deeper cognitive reflection (Toplak, West, and Stanovich 2011). Opposite to intuition, cognitive reflection is a fully conscious process (Evans 2008). Mindfulness, having shown to enhance present moment awareness (Brown and Ryan 2003), could therefore positively impact the way information is being processed. It may increase the tendency to engage in more deliberative cognitive reflection when a wrong intuitive impulse needs to be overridden.

The present study aims to contribute to literature by investigating the effects of a single brief mindfulness intervention on cognitive reflection tasks. An experimental online construct has been chosen for the examination. In the first section, the existing literature on cognitive processing and mindfulness is being discussed. Next, mindfulness is being linked to task engagement and cognitive reflection and possible hypotheses on the relationship are being formulated. This section is followed by the methodology and the results of the experiment. Finally, a discussion part contextualizes the results with existing literature to strengthen the findings and draw conclusions. The thesis presents limitations as well as recommendations for further research and concludes with a summary of the major findings.

Literature Review

Cognitive Processing

Humans have a tendency to be predictably irrational and this irrationality results from fast cognitive processing (Dane and Pratt 2007; Tversky and Kahneman 1973). People are “cognitive misers” (Toplak, West, and Stanovich 2011, 1283), as they prefer fast, effortless over slow, deliberate thinking. Hence, most of everyday choices are based on intuition (Bargh & Chartrand, 1999), as the process of drawing conclusions from reduced information simplifies the myriad of daily decisions (Westcott and Ranzoni 1963). This type of rapid cognitive processing with limited information is well documented in heuristic research. Heuristics intend to facilitate decisions and have proven to produce valid judgments (Gigerenzer 1996) but can also cause cognitive biases and lead to incorrect responses (Tversky and Kahneman 1973). Therefore, intuition is often juxtaposed with cognitive reflection, in which the latter is linked to more deliberative and slow thinking and has shown to be crucial for rational behavior (Toplak, West, and Stanovich 2011). This idea is reflected in the concept of the dual-process theory (see Evans 2008 for a review on dual-process models).

The dual-process approach differentiates two types of cognitive systems, frequently called System 1 and System 2 (Stanovich and West 2000). System 1 is described as associative (Sloman 1996) and experiential (Epstein 1994) while System 2 is defined as rule-based (Sloman 1996) and rational (Epstein 1994). One of the main distinctions between both systems is the level of consciousness during the cognitive process (Evans 2008). Whereas System 1 operates fast, automatically, effortlessly and without conscious awareness, System 2 works slowly, analytically, effortful and with high attention (Sinclair 2011). This thesis focuses on cognitive reflection, associated with System 2’s way of cognitive processing and constantly challenged by System 1’s intuitive impulses (Epstein 1994; Kahneman and Frederick 2005). Intuition is *direct knowing* whereby the sources of knowledge often remain unknown and unquestioned

(Sinclair 2011). Frequently associated with the term *gut* (Hayashi 2001), it implies unconscious and rapid information processing (Dane and Pratt 2007). Opposite to that exists cognitive reflection, which is the ability to ignore a first impulsive response coming to mind and to engage in deeper thinking to find the correct answer (Frederick 2005). Thus, cognitive reflection has been linked to patience (Frederick 2005) and rational-thinking (Toplak, West, and Stanovich 2011). Indeed, increased time taken on a task has been found to correlate with decision accuracy (Dane and Pratt 2007).

Mindfulness

The concept of mindfulness has its roots in the Buddhist traditional Vipassana practice, which takes one on an *inner journey* by focusing on the breath or scanning through the body. The objective is to reach equanimity, a state of freedom, and a balanced mind, free from worry and impulsiveness (Goleman and Davidson 2018). Although Vipassana practice has already been existing for over 2500 years, it only spread in the Western culture in the early 1970s (Kabat-Zinn 1991). Mindfulness represents a popular translation of the Pali¹ language's word *sati* (Goleman and Davidson 2018) and commonly stands for a "moment-to-moment, non-judgmental awareness" (Kabat-Zinn 2015, 1481). Its concept is also described as "a process of drawing novel distinctions" (Langer and Moldoveanu 2000, 2), as it makes one (1) more sensitive to the surrounding environment, (2) open to novelty, (3) aware of diverse perspectives in problem-solving, and (4) more involved in the present moment. Today, mindfulness has proven to serve not only as a therapeutic tool in psychology or medicine (Kabat-Zinn 2003), but also as an effective practice in the management context (Good et al. 2016). Growing interest in mindfulness can be explained by its positive effects on human well-being (Brown and Ryan 2003) and on different aspects of human functioning (Brown, Ryan, and Creswell 2007). Mindfulness has also shown to positively impact decision-making tasks (Dane 2008) and to

¹ Pali is a Buddhist language (Goleman and Davidson 2018)

reduce cognitive biases, like the sunk-cost (Hafenbrack, Kinias, and Barsade 2014) or negativity bias (Kiken and Shook 2011).

A mindful state may already be reached by a 15-minutes meditation induction (Arch and Craske 2006), although meditation is not seen as the only way to cultivate that state of awareness (Bishop et al. 2006). The impact of a single brief mindfulness session has often been considered as weak (Creswell 2017) or revealed to be ineffective (e.g., Jurkovič 2016) and is therefore much less explored than long-term interventions or trait related investigations. However, evidence indicates that a single brief mindfulness induction can affect different aspects of cognitive functioning (Alberts and Thewissen 2011; Mrazek, Smallwood, and Schooler 2012) and improve emotion regulation (Arch and Craske 2006). A 15-minutes meditation is easily feasible everywhere and anytime, which makes it an attractive tool for organizations seeking to minimize effort and costs (Hafenbrack, Kinias, and Barsade 2014). In contrast, long-term mindfulness interventions, aiming to develop a generally more mindful trait, can also be disadvantageous for companies. Indeed, being more mindful can have negative effects as well. Mindful individuals revealed to be more risk-averse and to avoid stress and challenges that get them forward in their careers (Brendel 2015). They tend to be more focused on the present, which can likewise turn into reduced motivation to learn from the past and plan for the future. An on-the-spot meditation induction, however, allows to make use of it adapted to the situation, whenever it has shown to be beneficial for the individual (Hafenbrack, Kinias, and Barsade 2014). Moreover, a brief mindfulness induction offers high experimental control due to its single application and short duration (Creswell 2017) and was thus chosen as the adequate intervention for this thesis.

Mindfulness & Task Engagement

Mindfulness, having shown to enhance involvement in the present moment (Langer and Moldoveanu 2000), suggests that mindful individuals may be more actively engaged in a task

at hand. Furthermore, it revealed to improve attentional focus (Mrazek, Smallwood, and Schooler 2012; Tang et al. 2007), which emphasizes that expectation. Stronger attentional focus has shown to reduce distraction from mind-wandering (Smallwood and Schooler 2015; Wiley and Jarosz 2012). Hence, it is expected that mindful individuals show higher task engagement due to enhanced attentional focus on the task.

Additionally, mindfulness has shown to reduce automatic reactions to stimuli (Glomb et al. 2011), which suggests that mindful individuals tend to pause before responding. It has also been linked to increased curiosity (Lau et al. 2006) and patience (Schnitker, 2012), which predicts that mindful individuals tend to take more time solving a task. High present moment involvement and enhanced attention to novelty, cultivated by a mindful state, underline that expectation (Langer and Moldoveanu 2000). Thus, this thesis hypothesizes that:

H₁: A brief mindfulness induction increases engagement with tasks - assessed by

H_{1a}: self-reported task focus and

H_{1b}: time taken on tasks.

Mindfulness & Cognitive Reflection

Mindfulness, having shown to enhance present moment awareness (Brown and Ryan 2003) and to reduce impulsiveness (Goleman and Davidson 2018), appears to relate more with System 2's conscious information processing characteristics than with fast, unconscious, heuristic thinking. When one is mindful, one is in a decentered state of self-observation creating a gap between stimuli and response (Bishop et al. 2006). Emotions and thoughts are observed without judgment and immediate and automatic reaction (Rosenstreich and Ruderman 2016). Keeping that non-judgmental distance to feelings and thoughts, mindful individuals may be less prone to draw fast conclusions from erroneous intuitive impulses. In fact, mindful individuals have shown to be more aware of external as well as internal stimuli. Hence, they are less inclined to cognitive failures (Herndon 2008). Based on that, one may infer that mindful

individuals tend to rely less on mental shortcuts generated by System 1 and thus, might be less exposed to cognitive biases.

Even though System 1 seems to be more prone to systematic errors (Tversky and Kahneman 1973), researchers agree that both systems, the intuitive as well as the reflective, have their validity and should not be seen as separate but complementary (Dane and Pratt 2007), as both can be considered as effective components of the decision-making process (Simon 1987). Indeed, most behavior originates in System 1, which generates a first intuitive answer and calls System 2 for support as soon as it is confronted with more analytical problems (Kahneman 2011). The ultimate skill is to know when to use which system. This requires high cognitive flexibility (Hodgkinson and Sadler-Smith 2003), which refers to the ability of choosing the correct response to stimuli (Frensch and Funke 1995). Cognitive flexibility has proven to be crucial for detecting wrong cognitive evaluations (Moore and Malinowski 2009) and for choosing amongst cognitive thinking styles (Hodgkinson and Sadler-Smith 2003). Mindfulness practice has been positively correlated to cognitive flexibility as it enhances one's ability to attend to changing thoughts and emotions and to react more reflectively to a situation (Bishop et al. 2006; Moore and Malinowski 2009). Thereupon, it is expected that a mindful state facilitates switching between the two cognitive processing techniques.

Considering all arguments mentioned above, it is predicted that mindful individuals are less inclined to rely on fast and wrong first thoughts initiated by System 1, but rather activate System 2 for more reflective thinking. Thus, it hypothesizes that:

H₂: A brief mindfulness induction increases performance on cognitive reflection tasks.

Expecting that mindfulness increases task engagement, suggests that higher task engagement will have mediating effects on the mindfulness and cognitive reflection relationship. Attentional focus is important for working memory capacities and therefore predicts higher performance at analytical problem-solving tasks (Wiley and Jarosz 2012). Thus,

it is expected that attentional control may also alter mindful individuals' performance on the cognitive reflection tasks, comprising brief problems to solve.

Further, expecting that mindful individuals are curious and tend to spend more time on a task, predicts that they are more open to effortful and slow information-processing and interested in exploring beyond the first intuitive thought coming to mind. Mindfulness, having been linked to increased patience (Schnitker 2012), which at the same time has shown to improve CRT performance (Frederick 2005), supports that expectation. Hence, this thesis also hypothesizes that:

H₃: The effect of mindfulness on cognitive reflection is mediated by engagement with tasks - as assessed by

H_{3a}: increased self-reported task focus and

H_{3b}: time taken on tasks.

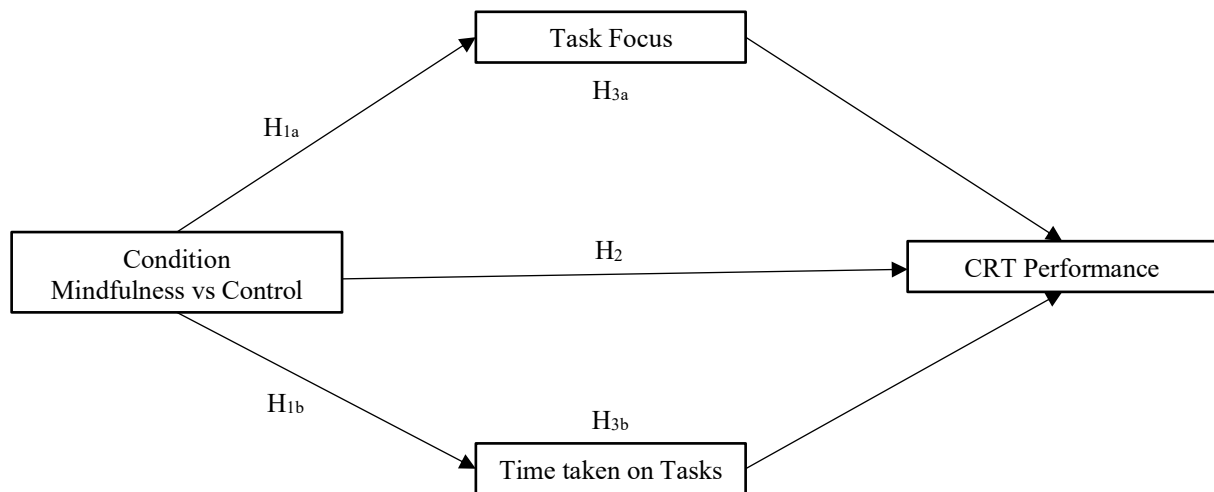


Figure 1: Conceptual Model

Methodology

The current study aims to investigate the immediate effects of a 15-minutes mindfulness induction on task engagement and performance on cognitive reflection tasks and whether increased task engagement mediates those effects. Task engagement is assessed by self-reported task focus and time taken on the tasks.

Participants

105 people completed the study (42 male, 63 female; $M_{age} = 25.9$ years, $SD_{age} = 8.47$ years)². 57 students from Nova School of Business & Economics participated in exchange for 0.2 bonus points on their final course grades via the Nova Behavioral Lab. 48 participants took voluntarily part via snowball sampling. Most participants were management students ($n=84$) and originally from Germany ($n=39$), Portugal ($n=36$) and France ($n=13$). Age, gender, and nationality were nearly equally distributed between the experiment and the control group. The amount of frequent or long-time meditators or yoga practitioners was small and balanced in both groups and therefore not excluded from the sample (see Table 1 and Figures in Appendix A for more details on the distribution). Further, only a few participants reported audio issues or distractions during the experiment (see Figures in Appendix B). The number was acceptably low as well as equally distributed between both conditions and thus, kept for the analysis.

Table 1: Descriptive of Variables

Variable	N	Minimum	Maximum	Mean	SD
Age	105	19 years	57 years	25.9 years	8.47 years
Gender (1 = male, 2 = female)	105	1	2	1.6	0.49
Meditation Practice	105	1	7	2.37	1.93
Meditation Experience	105	1	6	1.9	1.27
Yoga Practice	105	1	7	2.28	1.83
Yoga Experience	105	1	6	2.35	1.67

² According to Qualtrics, 8 surveys were not completed and therefore omitted from the sample.

Design & Procedure

A double blind 2 (mindfulness vs control) between-subject experimental design was used. The survey software randomly assigned participants to either a mindfulness or control condition. Participants and the experimenter were not aware which group they belonged to when the survey was being filled in. As the study was conducted entirely online due to the campus shutdown situation, participants were instructed to get a pair of headphones and find themselves a quiet place where they would not be disturbed during the experiment. They were told that they would listen to a 15-minutes audio-guided mental task exercise, complete some survey questions, and a cognitive reflection test.

After a short instruction on the procedure and a brief reading speed check task, participants listened to a 15-minutes meditation induction with differing instructions depending on the condition. Afterward, they completed the State Mindful Attention Awareness Scale (SMAAS; Brown and Ryan 2003), the Toronto Mindfulness Scale (TMS; Lau et al. 2006), the Cognitive Reflective Test (CRT; Frederick 2005; Thomson and Oppenheimer 2016), and the Task Focus Scale (TFS; Hafenbrack and Vohs 2018).

Independent Variable: Mindfulness & Control Inductions

Mindfulness Meditation Condition. Participants listened to a 15-minutes meditation recording guided by a professional mindfulness meditation teacher and known as an established intervention in the field of mindfulness (Arch and Craske 2006; Hafenbrack and Vohs 2018). The aim of the meditation was to induce a mindful state by directing the listeners' attention to the present moment. Participants were instructed to anchor their focus on the sensations of their breath, entering and leaving the body.

Control Condition. Participants of the control condition listened to the same 15-minutes meditation audio but were instructed to count the number of verbs occurring in the recording. Counting verbs during a guided meditation has shown to distract listeners from the

meditation as they engage in a cognitive task. Thus, the control group would not be exposed to the meditation's effects on their state of mindfulness. This method has been found to serve as a reliable control condition to a mindfulness intervention (Koole et al. 2009).

Measures

Details on the measures can be found in Appendix C.

Manipulation checks

SMAAS. After listening to the recording, all subjects had to respond to a 5-items state version of the Mindful Attention Awareness Scale (Brown and Ryan 2003). Participants had to indicate on a 5-point Likert Scale the extent to which they agree with each statement from 0 (not at all) to 4 (extremely). This manipulation check served to examine whether the mindfulness meditation intervention effectively induced a mindful state. All items were reversely scored and therefore recoded for the analysis (Cronbach's $\alpha = .84$)³.

TMS. Further, the 13-items self-reported TMS (Lau et al. 2006) was used as a second measure to analyze whether a mindfulness state was evoked. The TMS comprises two factors, curiosity and decentering. All items relating to curiosity measure an individual's present moment awareness with a sense of curiosity. The decentering items reflect an individual's awareness of a present experience without being distracted by thoughts and emotions (Lau et al. 2006). Participants had to indicate how they feel "right now" by rating each statement on a 5-point Likert scale from 0 (not at all) to 4 (very much) (Cronbach's $\alpha_{\text{Overall}} = .88$, Cronbach's $\alpha_{\text{Curiosity}} = .91$, Cronbach's $\alpha_{\text{Decentering}} = .73$).

Dependent Variables

CRT. An extended version of Frederick's (2005) 3-items CRT was used as a measure of reflective thinking. The CRT is widely applied in the research of the dual-process theory and

³ Cronbach's alpha serves to check the reliability of scales. It varies between .0 and 1 and should be above .7 for a scale to be acceptably reliable (Tavakol and Dennick 2011).

is designed to examine an individual's tendency to override an intuitive but wrong answer with a more deliberately thought through and analytical correct response.

Example task:

A bat and a ball cost \$1.10. The bat costs \$1.00 more than the ball.

How much does the ball cost? ___ \$

(Correct response = 0.05 \$ Intuitive response = 0.1 \$)

Questions from the CRT have proven to automatically cue an intuitive but wrong answer. In fact, the most mentioned wrong answer usually represents the intuitive one, which in the example above is 0.10 \$. In order to find the logically correct response, one has to activate System 2 for deeper cognitive processing. Thus, wrong answers in the CRT result from miserly information processing and correct answers can be associated with engagement in cognitive reflection (Frederick 2005). Therefore, the CRT has shown to be an important measure for understanding a person's way of cognitive processing in the context of the dual-process theory. Considering the CRT's high prevalence, subjects may have already been exposed to the commonly used 3-items test developed by Frederick. Considering this, the present study used an extended version, including another four questions developed by Thomson and Oppenheimer (2016).

Dependent Variable & Mediator: Task Engagement

Task engagement was assessed by the TFS and a timer on the CRT.

TFS. Right after the CRT, participants filled in the 6-items TFS (Hafenbrack and Vohs 2018). Three items were statements that related to the experience during the CRT, such as "I was able to focus completely on the task", whereas the other items referred to task-unrelated thoughts like "My mind wandered away from the task at hand" and therefore were reversely scored. Participants had to indicate on a 5-point Likert scale the extent to which they agree with the statements from 0 (not at all) to 4 (extremely) (Cronbach's $\alpha = .90$).

Time taken on CRT. Each CRT task was timed and assessed by the "Timing" type question on Qualtrics.

Control Variables

Reading speed and proficiency. Before starting with the audio, participants completed a reading robustness check exercise to control that increased time taken on the CRT was not due to reading difficulties (see Appendix D). Time taken to read a short passage was assessed, with participants being cued before the page that they would have to read it entirely from the first to the last word in order to respond to a question on the text. Participants were also required to indicate their level of English proficiency to control that potentially wrong answers on the test were wrong despite understanding the question well.

Familiarity with CRT. Participants had to indicate which of the seven CRT tasks they had seen before that day. Hence, familiarity with the tasks could be included as a covariate for the analysis. It was expected that previously seen tasks would be responded correctly.

Distracted participation. Some questions were related to the person's experience with the recording. As the experiment took place fully online, it was important to control the number of people who got disturbed or interrupted during the audio. This number had to be small and equally distributed between both conditions.

Finally, age, gender, nationality, and field of study were included as well as questions related to the participants' meditation and yoga experience and practice.

Results

Manipulation Checks

Prior to the hypotheses testing, two two-way ANOVAs were run on the SMAAS as well as TMS scores to investigate whether the mindfulness induction led to significant changes in state mindfulness between the conditions (mindfulness vs counting verbs). Gender was included as a second independent variable, as it revealed to affect the CRT performance, which is reported in a later part. This served to control whether it could potentially bias the effects of the condition. Results from both analyses show that participants in the mindfulness group

(SMAAS: $M = 3.38$, $SD = 0.91$; TMS: $M = 3.31$, $SD = 0.72$) did not report a significantly greater state mindfulness than those in the verbs counting group (SMAAS: $M = 3.26$, $SD = 1.06$; TMS: $M = 3.17$, $SD = 0.76$, all $F_s < 1.67$, all $p_s > .19$). Tests on the TMS subscales measuring two factors, curiosity and decentering, revealed that there were no significant differences between the mindfulness (TMS curiosity: $M = 3.64$, $SD = 0.97$; TMS decentering: $M = 3.02$, $SD = 0.69$) and the control condition (TMS curiosity: $M = 3.56$, $SD = 0.96$; TMS decentering: $M = 2.83$, $SD = 0.71$, all $F_s < 2.59$, all $p_s > .11$). These results indicate that the manipulation was not successful.

Additional analysis. The interaction effect between the two independent variables revealed to be insignificant, all $F_s (1, 101) < 1.64$, all $p_s > .20$. However, gender showed to have significant effects on the TMS scores. Regardless the condition, females ($M = 3.37$, $SD = 0.72$) reported to be significantly more mindful than males ($M = 3.04$, $SD = 0.72$, $F(1, 101) = 5.25$, $p = .02$). Looking at the TMS decentering scores, a significant difference between females ($M = 3.05$, $SD = 0.73$) and males ($M = 2.73$, $SD = 0.64$) was found, $F(1, 101) = 5.95$, $p = .02$. However, the TMS curiosity scores revealed no significant differences between females ($M = 3.73$, $SD = 0.97$) and males ($M = 3.41$, $SD = 0.97$, $F(1, 101) = 2.95$, $p = .09$). See Figure 2 for an overview on the TMS scores between gender in both conditions.

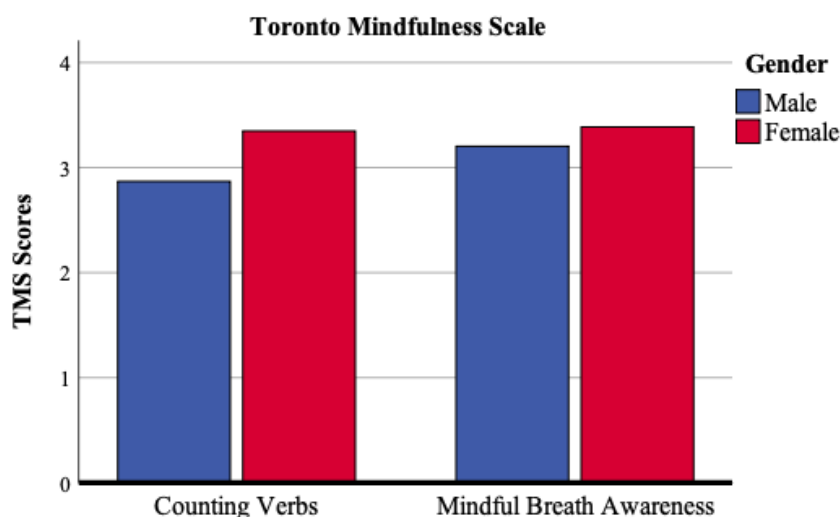


Figure 2: TMS Scores between Gender in both Conditions

The findings suggest that women had a higher present moment awareness. Thus, gender was included as a second factor in all further analyses for additional findings.

Direct Effects

Task focus. A two-way ANOVA was computed with the condition and gender as independent variables and task focus as dependent variable. No differences in task focus were observed between the mindfulness ($M = 4.00$, $SD = 1.02$) and the counting verbs condition ($M = 3.93$, $SD = 0.98$), $F(1, 101) = 0.43$, $p = .52$. This suggests that there were no differences between conditions in task focus. Therefore, H_{1a} is not supported.

Additional Analysis. The same can be concluded for the effect of gender. Males ($M = 4.00$, $SD = 1.02$) did not report to be more focused on the task than females ($M = 3.95$, $SD = 0.99$), $F(1, 101) = 0.04$, $p = .84$. Further, no significant interaction effect between task focus and gender can be reported, $F(1, 101) = 2.01$, $p = .16$.

Total time taken on CRT. Each participant took between 5.63 and 192.91 seconds ($M = 46.76$, $SD = 32.42$) to complete the 7 items in the CRT. A two-way ANCOVA, with mindfulness and gender as independent variables and reading speed as well as familiarity with CRT as covariates, was run to examine effects on the time taken on the CRT. No significant differences between the mindfulness ($M = 50.19$, $SD = 39.43$) and the verbs counting condition ($M = 43.40$, $SD = 23.55$) were found, $F(1, 99) = 2.04$, $p = .16$. However, the reading speed check, $F(1, 99) = 8.07$, $p < .01$, as well as familiarity with tasks, $F(1, 99) = 7.98$, $p < .01$, revealed to be significant covariates⁴. The correlation between time taken on CRT and reading speed check shows that the higher the time spent on the reading speed check, the higher the time taken on the CRT. The correlation between time taken on CRT with familiarity with the

⁴ Including English proficiency as a covariate did not change overall results. A higher English level did not predict less time spent on CRT.

tasks shows that the higher the familiarity with the tasks, the lower the time spent on them (see Figures in Appendix E). Those results do not support H_{1b} .

Additional Analysis. Gender did not have significant effects on the time taken on the CRT, $F(1, 99) = 0.15, p = .70$. Females ($M = 50.12, SD = 34.58$) did not spend significantly more time on the CRT than males ($M = 41.72, SD = 28.54$). The interaction effect between the two independent variables was insignificant as well, $F(1, 99) = 0.50, p = .48$.

Performance on CRT. Prior to the main analysis on the CRT performance, a Chi-Square test was run to examine the distribution of task familiarity across conditions and it was verified that the number of familiar tasks between both conditions was balanced, $\chi\text{-square} = 5.63, p = .58$ (see table 2 in Appendix F).

Then, a two-way ANCOVA was conducted, with the condition as independent variable and the total CRT score as dependent variable. Gender was included as second factor and familiarity with CRT as covariate. This analysis served to examine whether there was a difference between conditions on CRT performance. No significant differences between participants from the counting verbs ($M = 4.58, SD = 1.93$) and those from the mindfulness group ($M = 4.17, SD = 1.7$) were found, $F(1, 100) = 3.69, p = .06$. Familiarity with CRT was found to be a significant covariate, $F(1, 100) = 14.72, p < .001$, as most familiar tasks were solved correctly. Those results do not support H_2 , which predicted higher performance on CRT for the mindfulness condition (see Appendix G)

Additional analysis. Gender, however, showed to have significant effects on the CRT performance, $F(1, 100) = 9.90, p < .01$. Males ($M = 5.24, SD = 1.36$) solved significantly more cognitive reflection tasks than females ($M = 3.81, SD = 1.87$), as illustrated in Figure 3. The interaction effect between gender and the condition, however, was insignificant, $F(1, 100) = 1.99, p = .16$.

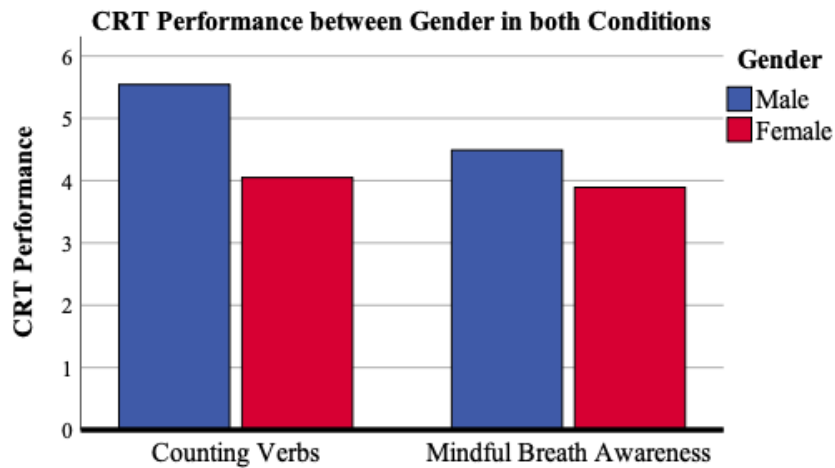


Figure 3: CRT Performance between Gender in both Conditions

Mediating Effects

A PROCESS macro was run to test whether the time taken on the tasks as well as task focus have a mediating effect on the CRT performance (Model 4; Hayes 2018). Gender and familiarity with CRT were included as covariates in the model. The results show again, that the total effect of the independent variable has no significant effects on the dependent variable, $c = -0.51$, $t(101) = -1.66$, $p = .10$, as illustrated in Figure 4. Further, the direct relationship between the condition and the two mediators, task focus, $a_1 = 0.06$, $t(101) = 0.33$, $p = .74$, as well as time taken on CRT, $a_2 = 7.70$, $t(101) = 1.26$, $p = .21$, were found to be insignificant. However, both mediators, task focus, $b_1 = 0.46$, $t(99) = 3.06$, $p < .01$, as well as time taken on CRT, $b_2 = 0.01$, $t(99) = 2.05$, $p = .04$, revealed to significantly impact CRT performance. Additionally, a significant direct effect from the condition on the CRT performance was found, $c' = -0.62$, $t(99) = -2.08$, $p = .04$). Overall, no mediation effects have been found, neither for task focus (indirect effect = 0.03; 95% CI [-0.17, 0.23]), nor for the time taken on tasks (indirect effect = 0.08; 95% CI [-0.03, 0.29]). Both mediating results are insignificant as the bootstrapping confidence interval of the total indirect effect includes zero (Hayes 2018). More details on the results can be found in Appendix H. Those findings suggest that higher task engagement, assessed by task focus and time taken on the CRT, does not mediate the link

between a brief mindfulness induction and CRT performance. Those results do not support H_{3a} and H_{3b} . Nevertheless, the significant direct effect between the condition and CRT performance also indicates that meditating compared to counting verbs reduces total CRT performance. Thus, H_2 was not supported.

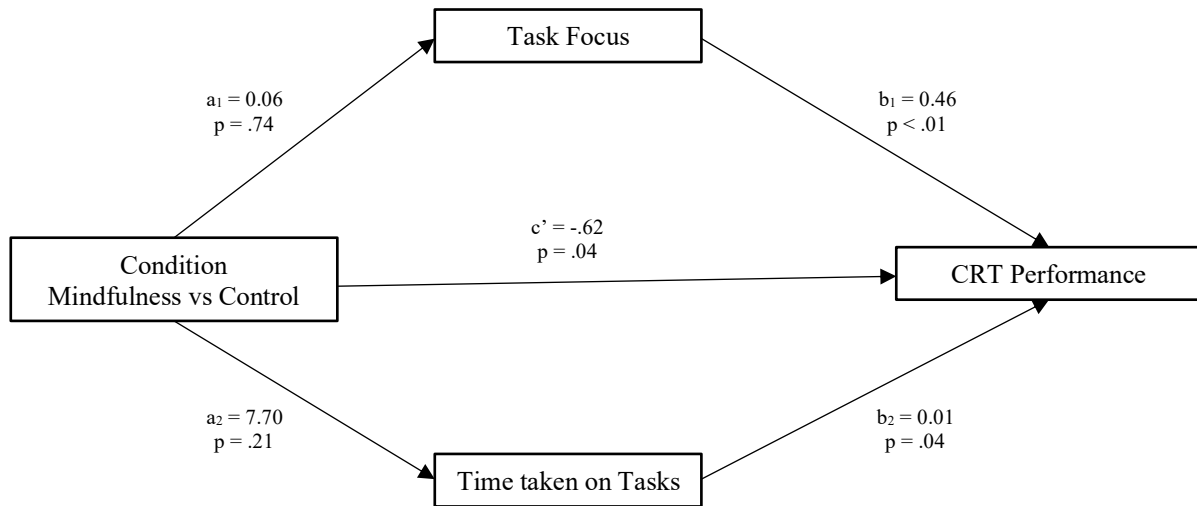


Figure 4: Conceptual Model Mediation Effects

Additional analysis. Another PROCESS analysis was run to investigate whether gender moderates the effects of the condition on CRT performance and the condition on the mediators (Model 8; Hayes 2018). Gender has shown to have no significant moderating effects on the relationship between condition and mediators, task focus, $a_3 = -0.48$, $t(100) = -1.20$, $p = .23$, and time spent on task, $a_4 = 9.13$, $t(100) = 0.72$, $p = .47$ (see Figure 5). In addition, gender did not have significant moderating effects on the condition and CRT performance relationship, $a_5 = 1.05$, $t(98) = 1.72$, $p = .09$. However, when looking at males only, a significant direct effect from the condition on CRT performance was found (direct effect = -1.25 ; 95% CI $[-2.18, -0.32]$), which indicates reduced performance after the meditation relative to the counting verbs condition. Finally, both indirect effects on the mediations of condition and CRT performance revealed to be insignificant (task focus: indirect effect = -0.24 ; 95% CI $[-0.78, 0.17]$; time taken

on tasks: indirect effect = -0.09; 95% CI [-0.15, 0.45]). Those findings indicate that no moderated mediation effects have been found.

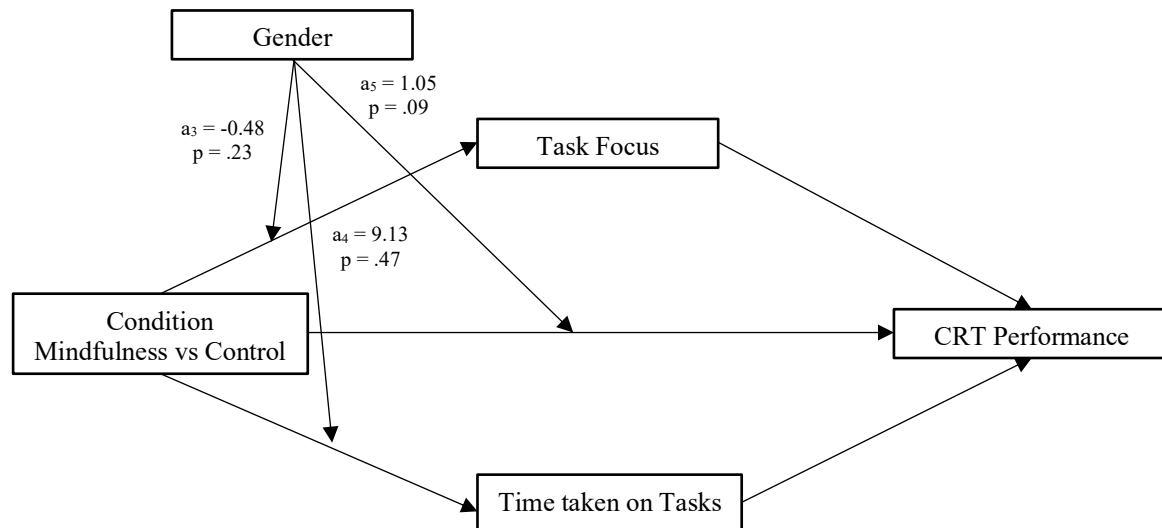


Figure 5: Conceptual Model Moderated Mediation Effects

Discussion

Differences in conditions did neither reveal to evoke significant differences in the manipulation check scores nor in participants' task engagement. No differences in task focus or time spent on tasks between conditions were found. Therefore, hypothesis 1, suggesting that a brief mindfulness induction increases engagement with tasks, was not supported.

It may be that the mindfulness induction did not evoke higher TMS or SMAAS scores as the counting verbs condition did not represent a suitable comparison condition. Even though the counting verbs instruction was already used as a control condition to a mindfulness intervention (Koole et al. 2009), participants in that study were not asked to indicate how mindful they were afterward. There is no evidence that it induces a lower mindful state and consequently, it remains unclear whether the mindfulness induction was successful. Perhaps the counting verbs condition even induced an enhanced present moment awareness, as participants were highly concentrated on the counting instruction, which may explain similar results on the SMAAS containing statements related to mind-wandering (Brown and Ryan

2003). Statements like “I find it difficult to stay focused on what’s happening in the present”, was likely not the case for participants who had to focus on counting verbs for 15 minutes. Most mindfulness interventions use a 15-minutes mind-wandering audio as a control condition (e.g., Arch and Craske 2006; Hafenbrack and Vohs 2018) as it evokes a state of non-attendance to the present moment where attention is drawn towards unrelated emotions and thoughts (Mrazek, Smallwood, and Schooler 2012). Even though mind-wandering has been described as a default mode of neural networks (Mason et al. 2007), this popular control condition was replaced with the counting verbs instructions on the meditation because of ethical considerations that letting people mind-wander during COVID-19 would inadvertently increase their anxiety. It may be that the originally planned mind-wandering induction may have evoked lower SMAAS and TMS scores.

This may also explain why the effects on task focus and time taken on the tasks were insignificant. Apart from the assumption that the counting verbs induction may not have represented a reliable control condition, it may even have contributed to increased task engagement. Counting verbs for 15 minutes is a cognitively demanding and highly engaging task. Studies reporting that mindfulness improves attention on tasks either used mind-wandering inductions or relaxing activities as a control condition (e.g., Mrazek, Smallwood, and Schooler 2012; Tang et al. 2007; Zeidan et al. 2010). An active control condition, where attention is drawn to a mental task, might have had positive effects on task focus and therefore might have been at least as effective as the mindfulness induction. Compared to the commonly used mind-wandering condition, it is imaginable that participants, who were engaged mentally for 15 minutes reported higher task focus than if they had let their minds wander. This idea is supported by the results showing above-average task focus scores for both conditions. Moreover, it is likely that a mind-wandering induction, in contrary to the verbs counting control condition, would have reduced the time spent on the tasks. In fact, mind-wandering has been

found to correlate with shorter response time on tasks (Smallwood, McSpadden, and Schooler 2007). All arguments mentioned above suggest that the counting verbs instruction may have not represented a suitable control condition. Thus, it can only be concluded that the mindfulness induction, relative to the counting verbs, had no impact on task engagement, but relative to other control conditions there may be an effect (e.g., Hafenbrack and Vohs 2018).

Those possibilities potentially explain results on the CRT performance as well. Findings of a first analysis indicate no significant relationship between the condition and CRT performance. However, when including the mediators in the model, a second analysis revealed that participants from the verbs counting condition performed significantly better on the CRT than those from the mindfulness condition. This indicates that, although no differences in SMAAS and TMS scores have been found, the conditions still affected CRT performance. It suggests, contrary to what was expected from hypothesis 2, that a brief mindfulness induction, relative to the counting verbs control condition, decreases performance on the CRT. Even though most literature on mindfulness examines its benefits, studies revealed that mindfulness can also have negative effects (e.g., Britton 2019; Cebolla et al. 2017; Hafenbrack and Vohs 2018). Indeed, mindfulness has been found to reduce task motivation (Hafenbrack and Vohs 2018), which may have led to reduced performance on the CRT. Informal feedback from participants after the experiment revealed that especially unexperienced meditators found it difficult to engage in the meditation and to fully focus on the breathing. Some participants informally reported having felt sleepy afterward. Future researchers interested in the topic may assess task motivation and the participants' state of arousal with the PANAS-X scale for instance (Watson and Clark 1999) to verify these qualitative reports.

Furthermore, those findings also suggest that the control condition may have positively affected CRT performance. For the counting verbs instruction participants were required to activate their working memory and numerical abilities, which likely served as a short “warm-

up” for the ensuing CRT, mostly containing mathematical items (Frederick 2005; Thomson and Oppenheimer 2016). Indeed, numeracy skills have shown to improve CRT performance (Frederick 2005). Also, debriefing with participants from the verbs counting condition, revealed that they felt highly engaged in the exercise. The majority were keen on verifying that the number of verbs counted was correct.

Those findings may encourage researchers to further investigate the effects of mindfulness on CRT performance. Even if results suggest that mindfulness reduces CRT performance, it is difficult to draw clear conclusions on hypothesis 2, as it remains unclear whether significant differences between conditions are due to negative effects of the mindfulness condition or positive effects of the verbs counting condition. Future researchers should feel encouraged to use multiple control conditions, including for example a mind-wandering induction, as it has shown to impair task performance (Smallwood, McSpadden, and Schooler 2007) and would thus represent a better comparison condition.

Finally, task engagement assessed by task focus and time spent on task revealed to have no significant mediating effects on the condition and CRT performance relationship. Hence, hypothesis 3 was not supported. Nevertheless, results show that task focus as well as time spent on the tasks significantly improve CRT performance. Hence, this part of the model makes sense and can serve as a basis for future research in the field of reducing cognitive errors by increased task focus and time spent.

In addition to the findings demonstrated previously, further analyses on gender as a second factor have been made. Even though no interaction effect between gender and the condition was found, results reflect previous research that men perform significantly better on the CRT than women (Frederick 2005). Moreover, a moderated mediation analysis using gender as a moderator found that amongst males, those in the counting verbs condition revealed to have significantly higher CRT scores relative to those meditating. This is in line with what

has been suggested before, that the mindfulness group performed worse on the CRT relative to the control condition. Results also indicate that females reported to be significantly more mindful than males according to the TMS scores, which has not been confirmed by previous findings, reporting no significant differences between gender on the same scale (Lau et al. 2006). Only a small amount of literature suggests that the effectiveness of mindfulness interventions can be explained by differences in gender whereby females represent the more affected (Katz and Toner 2013). In the current study, the number of male participants was relatively small compared to females. It remains unclear, whether an increased number of male participants would have generated same results.

Limitations

Several factors may also limit conclusions drawn from the present study. First, as the study could not be carried out on campus due to COVID-19 lockdown policies, it was conducted online and thus, lacked the controlled environment of the lab. Even though questions were asked at the end of the survey to determine not attentive or weak participation, it may be that participants in the mindfulness condition were more affected by distractions than the control condition due to unequal home participation conditions. That is, reaching a state of mindfulness is facilitated by quiet conditions of meditation.

Second, as the experiment took place right at the beginning of the COVID-19 campus closures, it is likely that participants were faced with many uncertainties that made it difficult to calm their minds during the meditation and fully focus on their breath. Indeed, recent surveys related to COVID-19 show the prevalence of stress, depression, and anxiety amongst those questioned (Liu et al. 2020). Even if meditation is considered being an effective tool in response to COVID-19 anxiety (Brewer 2020; CDC 2020), it still confronts people with their thoughts and feelings, which is particularly difficult under current circumstances. Indeed, a COVID-19 study revealed that people prefer several other activities over meditating (Hussain 2020).

Hence, the mindfulness induction may have been less effective than under different circumstances whereas the counting task that has actively drawn attention on an actional task was a good distractor to their thoughts.

Third, the participants' high familiarity with the CRT indicates that results may be biased. Most of the participants (71%) have seen at least one of the seven tasks before (see Table 3 in Appendix F). Especially participants who had decision-making classes, have more likely been confronted with CRTs already (Welsh and Begg 2017). This is the case for a high number of management students, who represented the majority of the sample. Knowing some of the items may have alerted participants to the nature of the CRT, in which the first solution coming to mind is not the correct one. Thus, higher CRT scores may have not resulted from cognitive reflection but from greater numerical and reading comprehension skills, which have shown to aid performance on CRT (Frederick 2005).

Suggestions for Further Research

In the CRT, a wrong answer commonly stems from intuition, whereas a correct answer derives from cognitive reflection. Thus, the CRT depicts intuition as less effective than cognitive reflection, which can likewise be found in literature (e.g., Shiloh, Salton, and Sharabi 2002; Tversky and Kahneman 1973). However, intuition has also shown to be highly valuable for the decision-making process and appears to be even better than other decision-making approaches under certain circumstances (Hammond 1996). Indeed, intuition reveals to be especially effective under time pressure (Hayashi 2001) and in particularly uncertain environments (Khatri and Ng 2000). Managers often decide intuitively when dealing with complex problems, which cannot be solved by certain rules. Thus, intuition has its validity when applied appropriately.

Even if the process of intuition has been defined as unconscious, the outcome, however, also referred to as intuitive judgment, is accessible to the conscious mind (Dane and Pratt 2007).

This suggests that enhanced attention on intuitive outcomes may help to evaluate its accuracy before using it for the decision-making process (Kahneman and Frederick 2005). Mindfulness, making one generally more attentive to the present moment and surrounding stimuli, have more cognitive flexibility (Moore and Malinowski 2009), as well as higher awareness of cognition (Kudesia 2019), predicts that mindful individuals may be more skilled to choose between intuition and cognitive reflection adapted to the context. This should encourage further researchers in the field to not only investigate whether mindful individuals have a higher tendency to engage in cognitive reflection, but to examine as well whether they are more aware of their intuition and thus, more capable of detecting whether their intuition is wrong or correct.

Conclusion

Even though mindfulness has shown to make decisions more effective (Dane 2008) and people less inclined to cognitive biases (Hafenbrack, Kinias, and Barsade 2014; Kiken and Shook 2011), the opposite was found in the present study, investigating the effects of a brief mindfulness intervention on cognitive reflection tasks. Contrary to what has been predicted, results suggest that mindfulness reduces engagement in cognitive reflection when a first intuitive response is cued in the mind. This indicates that mindfulness leads to worse decisions when cognitive reflection is required for the correct response. Thus, this thesis adds to the literature on the negative effects of mindfulness in the context of decision-making by showing that mindfulness impairs cognitive reflection. Nevertheless, it is notable that the chosen control condition as well as the COVID-19 circumstances implied several limitations of the results. Thus, future researchers should feel encouraged to verify those findings and further investigate the topic.

References

- Alberts, Hugo J. E. M., and Roy Thewissen. 2011. 'The Effect of a Brief Mindfulness Intervention on Memory for Positively and Negatively Valenced Stimuli'. *Mindfulness* 2 (2): 73–77. <https://doi.org/10.1007/s12671-011-0044-7>.
- Arch, Joanna J., and Michelle G. Craske. 2006. 'Mechanisms of Mindfulness: Emotion Regulation Following a Focused Breathing Induction'. *Behaviour Research and Therapy* 44 (12): 1849–58. <https://doi.org/10.1016/j.brat.2005.12.007>.
- Bishop, Scott R., Mark Lau, Shauna Shapiro, Linda Carlson, Nicole D. Anderson, James Carmody, Zindel V. Segal, et al. 2006. 'Mindfulness: A Proposed Operational Definition'. *Clinical Psychology: Science and Practice* 11 (3): 230–41. <https://doi.org/10.1093/clipsy.bph077>.
- Brendel, David. 2015. 'There Are Risks to Mindfulness at Work'. *Harvard Business Review*, 11 February 2015. <https://hbr.org/2015/02/there-are-risks-to-mindfulness-at-work>.
- Brewer, Judson. 2020. 'Anxiety Is Contagious. Here's How to Contain It.' *Harvard Business Review*, 18 March 2020. <https://hbr.org/2020/03/anxiety-is-contagious-heres-how-to-contain-it>.
- Britton, Willoughby B. 2019. 'Can Mindfulness Be Too Much of a Good Thing? The Value of a Middle Way'. *Current Opinion in Psychology* 28 (August): 159–65. <https://doi.org/10.1016/j.copsyc.2018.12.011>.
- Brown, Kirk Warren, and Richard M. Ryan. 2003. 'The Benefits of Being Present: Mindfulness and Its Role in Psychological Well-Being.' *Journal of Personality and Social Psychology* 84 (4): 822–48. <https://doi.org/10.1037/0022-3514.84.4.822>.
- Brown, Kirk Warren, Richard M. Ryan, and J. David Creswell. 2007. 'Mindfulness: Theoretical Foundations and Evidence for Its Salutary Effects'. *Psychological Inquiry* 18 (4): 211–37. <https://doi.org/10.1080/10478400701598298>.
- CDC. 2020. 'Coronavirus Disease 2019 (COVID-19)'. Centers for Disease Control and Prevention. 11 February 2020. <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/managing-stress-anxiety.html>.
- Cebolla, Ausiàs, Marcelo Demarzo, Patricia Martins, Joaquim Soler, and Javier Garcia-Campayo. 2017. 'Unwanted Effects: Is There a Negative Side of Meditation? A Multicentre Survey'. Edited by Robert K Hills. *PLOS ONE* 12 (9): e0183137. <https://doi.org/10.1371/journal.pone.0183137>.
- Creswell, J. David. 2017. 'Mindfulness Interventions'. *Annual Review of Psychology* 68 (1): 491–516. <https://doi.org/10.1146/annurev-psych-042716-051139>.
- Dane, Erik. 2008. 'EXAMINING EXPERIENCE AND ITS ROLE IN DYNAMIC VERSUS STATIC DECISION-MAKING EFFECTIVENESS AMONG PROFESSIONALS.' *Academy of Management Proceedings* 2008 (1): 1–6. <https://doi.org/10.5465/ambpp.2008.33641768>.
- Dane, Erik, and Michael G. Pratt. 2007. 'Exploring Intuition and Its Role in Managerial Decision Making'. *Academy of Management Review* 32 (1): 33–54. <https://doi.org/10.5465/amr.2007.23463682>.
- Epstein, Seymour. 1994. 'Integration of the Cognitive and the Psychodynamic Unconscious'. *American Psychologist*, 16.
- Evans, Jonathan St. B. T. 2008. 'Dual-Processing Accounts of Reasoning, Judgment, and Social Cognition'. *Annual Review of Psychology* 59 (1): 255–78. <https://doi.org/10.1146/annurev.psych.59.103006.093629>.
- Frederick, Shane. 2005. 'Cognitive Reflection and Decision Making'. *Journal of Economic Perspectives* 19 (4): 25–42. <https://doi.org/10.1257/089533005775196732>.
- Frensch, Peter A., and Joachim Funke, eds. 1995. *Complex Problem Solving: The European*

- Perspective*. Hillsdale, N.J: L. Erlbaum Associates.
- Gigerenzer, Gerd. 1996. 'On Narrow Norms and Vague Heuristics: A Reply to Kahneman and Tversky.' *Psychological Review* 103 (3): 592–96. <https://doi.org/10.1037/0033-295X.103.3.592>.
- Glomb, Theresa M., Michelle K. Duffy, Joyce E. Bono, and Tao Yang. 2011. 'Mindfulness at Work'. In *Research in Personnel and Human Resources Management*, edited by Aparna Joshi, Hui Liao, and Joseph J. Martocchio, 30:115–57. Emerald Group Publishing Limited. [https://doi.org/10.1108/S0742-7301\(2011\)0000030005](https://doi.org/10.1108/S0742-7301(2011)0000030005).
- Goleman, Daniel, and Richard J Davidson. 2018. *Altered Traits: Science Reveals How Meditation Changes Your Mind, Brain, and Body*.
- Good, Darren J., Christopher J. Lyddy, Theresa M. Glomb, Joyce E. Bono, Kirk Warren Brown, Michelle K. Duffy, Ruth A. Baer, Judson A. Brewer, and Sara W. Lazar. 2016. 'Contemplating Mindfulness at Work: An Integrative Review'. *Journal of Management* 42 (1): 114–42. <https://doi.org/10.1177/0149206315617003>.
- Hafenbrack, Andrew C., Zoe Kinias, and Sigal G. Barsade. 2014. 'Debiasing the Mind Through Meditation: Mindfulness and the Sunk-Cost Bias'. *Psychological Science* 25 (2): 369–76. <https://doi.org/10.1177/0956797613503853>.
- Hafenbrack, Andrew C., and Kathleen D. Vohs. 2018. 'Mindfulness Meditation Impairs Task Motivation but Not Performance'. *Organizational Behavior and Human Decision Processes* 147 (July): 1–15. <https://doi.org/10.1016/j.obhdp.2018.05.001>.
- Hammond, Kenneth R. 1996. *Human Judgment and Social Policy: Irreducible Uncertainty, Inevitable Error, Unavoidable Injustice*. New York: Oxford University Press.
- Hayashi, Alden M. 2001. 'When to Trust Your Gut'. *Harvard Business Review*, 1 February 2001. <https://hbr.org/2001/02/when-to-trust-your-gut>.
- Hayes, Andrew F. 2018. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. Second edition. Methodology in the Social Sciences. New York: Guilford Press.
- Herndon, Felix. 2008. 'Testing Mindfulness with Perceptual and Cognitive Factors: External vs. Internal Encoding, and the Cognitive Failures Questionnaire'. *Personality and Individual Differences* 44 (1): 32–41. <https://doi.org/10.1016/j.paid.2007.07.002>.
- Hodgkinson, Gerard P., and Eugene Sadler-Smith. 2003. 'Complex or Unitary? A Critique and Empirical Re-Assessment of the Allinson-Hayes Cognitive Style Index'. *Journal of Occupational and Organizational Psychology* 76 (2): 243–68. <https://doi.org/10.1348/096317903765913722>.
- Hussain, Amar. 2020. 'Most Popular Hobbies During the Coronavirus Outbreak [Survey]'. *Nerd Bear* (blog). 26 March 2020. <https://nerdbear.com/popular-hobbies-coronavirus-outbreak-survey/>.
- Jurkovič, Marek. 2016. 'EFFECT OF SHORT-TERM MINDFULNESS INDUCTION ON MYSIDE BIAS AND MISERLY PROCESSING: A PRELIMINARY STUDY'. *Studia Psychologica* 58 (3): 231–37. <https://doi.org/10.21909/sp.2016.03.719>.
- Kabat-Zinn, Jon. 1991. *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness ...* New York: Dell.
- Kabat-Zinn, Jon. 2003. 'Mindfulness-Based Interventions in Context: Past, Present, and Future'. *Clinical Psychology: Science and Practice* 10 (2): 144–56. <https://doi.org/10.1093/clipsy.bpg016>.
- Kabat-Zinn, Jon. 2015. 'Mindfulness'. *Mindfulness* 6 (6): 1481–83. <https://doi.org/10.1007/s12671-015-0456-x>.
- Kahneman, Daniel. 2011. *Thinking, Fast and Slow*. 1st ed. New York: Farrar, Straus and Giroux.
- Kahneman, Daniel, and Shane Frederick. 2005. 'A Model of Heuristic Judgment', 27.

- Katz, Danielle, and Brenda Toner. 2013. 'A Systematic Review of Gender Differences in the Effectiveness of Mindfulness-Based Treatments for Substance Use Disorders'. *Mindfulness* 4 (4): 318–31. <https://doi.org/10.1007/s12671-012-0132-3>.
- Khatri, Naresh, and H. Alvin Ng. 2000. 'The Role of Intuition in Strategic Decision Making'. *Human Relations* 53 (1): 57–86. <https://doi.org/10.1177/0018726700531004>.
- Kiken, Laura G., and Natalie J. Shook. 2011. 'Looking Up: Mindfulness Increases Positive Judgments and Reduces Negativity Bias'. *Social Psychological and Personality Science* 2 (4): 425–31. <https://doi.org/10.1177/1948550610396585>.
- Koole, Sander L., Olesya Govorun, Clara Michelle Cheng, and Marcello Gallucci. 2009. 'Pulling Yourself Together: Meditation Promotes Congruence between Implicit and Explicit Self-Esteem'. *Journal of Experimental Social Psychology* 45 (6): 1220–26. <https://doi.org/10.1016/j.jesp.2009.05.018>.
- Kudesia, Ravi S. 2019. 'Mindfulness As Metacognitive Practice'. *Academy of Management Review* 44 (2): 405–23. <https://doi.org/10.5465/amr.2015.0333>.
- Langer, Ellen J., and Mihnea Moldoveanu. 2000. 'The Construct of Mindfulness'. *Journal of Social Issues* 56 (1): 1–9. <https://doi.org/10.1111/0022-4537.00148>.
- Lau, Mark A., Scott R. Bishop, Zindel V. Segal, Tom Buis, Nicole D. Anderson, Linda Carlson, Shauna Shapiro, James Carmody, Susan Abbey, and Gerald Devins. 2006. 'The Toronto Mindfulness Scale: Development and Validation'. *Journal of Clinical Psychology* 62 (12): 1445–67. <https://doi.org/10.1002/jclp.20326>.
- Liu, Shuai, Lulu Yang, Chenxi Zhang, Yu-Tao Xiang, Zhongchun Liu, Shaohua Hu, and Bin Zhang. 2020. 'Online Mental Health Services in China during the COVID-19 Outbreak'. *The Lancet Psychiatry* 7 (4): e17–18. [https://doi.org/10.1016/S2215-0366\(20\)30077-8](https://doi.org/10.1016/S2215-0366(20)30077-8).
- Mason, M. F., M. I. Norton, J. D. Van Horn, D. M. Wegner, S. T. Grafton, and C. N. Macrae. 2007. 'Wandering Minds: The Default Network and Stimulus-Independent Thought'. *Science* 315 (5810): 393–95. <https://doi.org/10.1126/science.1131295>.
- Moore, Adam, and Peter Malinowski. 2009. 'Meditation, Mindfulness and Cognitive Flexibility'. *Consciousness and Cognition* 18 (1): 176–86. <https://doi.org/10.1016/j.concog.2008.12.008>.
- Mrazek, Michael D., Jonathan Smallwood, and Jonathan W. Schooler. 2012. 'Mindfulness and Mind-Wandering: Finding Convergence through Opposing Constructs.' *Emotion* 12 (3): 442–48. <https://doi.org/10.1037/a0026678>.
- Rosenstreich, Eyal, and Lital Ruderman. 2016. 'Not Sensitive, yet Less Biased: A Signal Detection Theory Perspective on Mindfulness, Attention, and Recognition Memory'. *Consciousness and Cognition* 43 (July): 48–56. <https://doi.org/10.1016/j.concog.2016.05.007>.
- Saint-Exupéry, Antoine de. 2017. *The Little Prince*.
- Schnitker, Sarah A. 2012. 'An Examination of Patience and Well-Being'. *The Journal of Positive Psychology* 7 (4): 263–80. <https://doi.org/10.1080/17439760.2012.697185>.
- Shiloh, Shoshana, Efrat Salton, and Dana Sharabi. 2002. 'Individual Differences in Rational and Intuitive Thinking Styles as Predictors of Heuristic Responses and Framing Effects'. *Personality and Individual Differences* 32 (3): 415–29. [https://doi.org/10.1016/S0191-8869\(01\)00034-4](https://doi.org/10.1016/S0191-8869(01)00034-4).
- Simon, Herbert A. 1987. 'Making Management Decisions: The Role of Intuition and Emotion'. *Academy of Management Perspectives* 1 (1): 57–64. <https://doi.org/10.5465/ame.1987.4275905>.
- Sinclair, Marta. 2011. *Handbook of Intuition Research*. Cheltenham ; Northampton, MA: Edward Elgar Publishing Limited.
- Sloman, Steven A. 1996. 'The Empirical Case for Two Systems of Reasoning', 20.

- Smallwood, Jonathan, Merrill McSpadden, and Jonathan W. Schooler. 2007. 'The Lights Are on but No One's Home: Meta-Awareness and the Decoupling of Attention When the Mind Wanders'. *Psychonomic Bulletin & Review* 14 (3): 527–33. <https://doi.org/10.3758/BF03194102>.
- Smallwood, Jonathan, and Jonathan W. Schooler. 2015. 'The Science of Mind Wandering: Empirically Navigating the Stream of Consciousness'. *Annual Review of Psychology* 66 (1): 487–518. <https://doi.org/10.1146/annurev-psych-010814-015331>.
- Stanovich, Keith E., and Richard F. West. 2000. 'Individual Differences in Reasoning: Implications for the Rationality Debate?', 82.
- Tang, Y.-Y., Y. Ma, J. Wang, Y. Fan, S. Feng, Q. Lu, Q. Yu, et al. 2007. 'Short-Term Meditation Training Improves Attention and Self-Regulation'. *Proceedings of the National Academy of Sciences* 104 (43): 17152–56. <https://doi.org/10.1073/pnas.0707678104>.
- Tavakol, Mohsen, and Reg Dennick. 2011. 'Making Sense of Cronbach's Alpha'. *International Journal of Medical Education* 2 (June): 53–55. <https://doi.org/10.5116/ijme.4dfb.8dfd>.
- Thomson, Keela S, and Daniel M Oppenheimer. 2016. 'Investigating an Alternate Form of the Cognitive Reflection Test'. *Judgment and Decision Making* 11 (1): 15.
- Toplak, Maggie E., Richard F. West, and Keith E. Stanovich. 2011. 'The Cognitive Reflection Test as a Predictor of Performance on Heuristics-and-Biases Tasks'. *Memory & Cognition* 39 (7): 1275–89. <https://doi.org/10.3758/s13421-011-0104-1>.
- Tversky, Amos, and Daniel Kahneman. 1973. 'Judgment under Uncertainty: Heuristics and Biases', 37.
- Watson, David, and Lee Anna Clark. 1999. 'THE PANAS-X. Manual for the Positive and Negative Affect Schedule - Expanded Form'. *The University of Iowa*.
- Welsh, Matthew Brian, and Steve H Begg. 2017. 'The Cognitive Reflection Test: Familiarity and Predictive Power in Professionals', 6.
- Westcott, Malcolm R., and Jane H. Ranzoni. 1963. 'Correlates of Intuitive Thinking'. *Psychological Reports* 12 (2): 595-613E. <https://doi.org/10.2466/pr0.1963.12.2.595>.
- Wiley, Jennifer, and Andrew F. Jarosz. 2012. 'Working Memory Capacity, Attentional Focus, and Problem Solving'. *Current Directions in Psychological Science* 21 (4): 258–62. <https://doi.org/10.1177/0963721412447622>.
- Zeidan, Fadel, Susan K. Johnson, Bruce J. Diamond, Zhanna David, and Paula Goolkasian. 2010. 'Mindfulness Meditation Improves Cognition: Evidence of Brief Mental Training'. *Consciousness and Cognition* 19 (2): 597–605. <https://doi.org/10.1016/j.concog.2010.03.014>.

Appendices

Appendix A: Participant Information

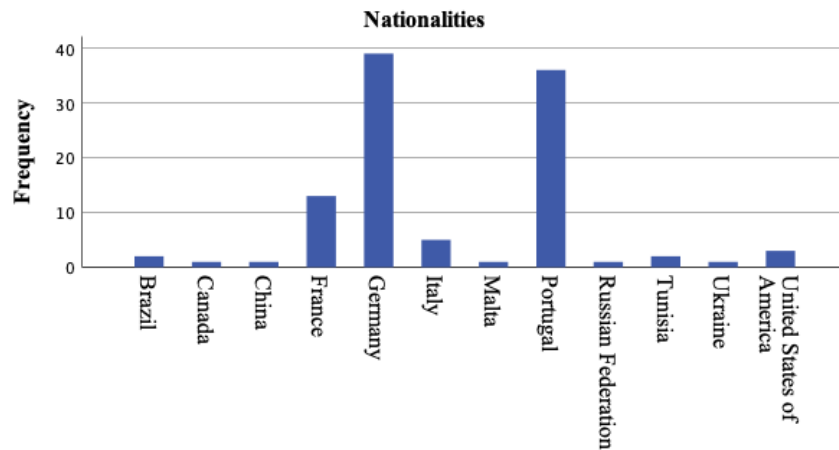


Figure 6: Nationalities

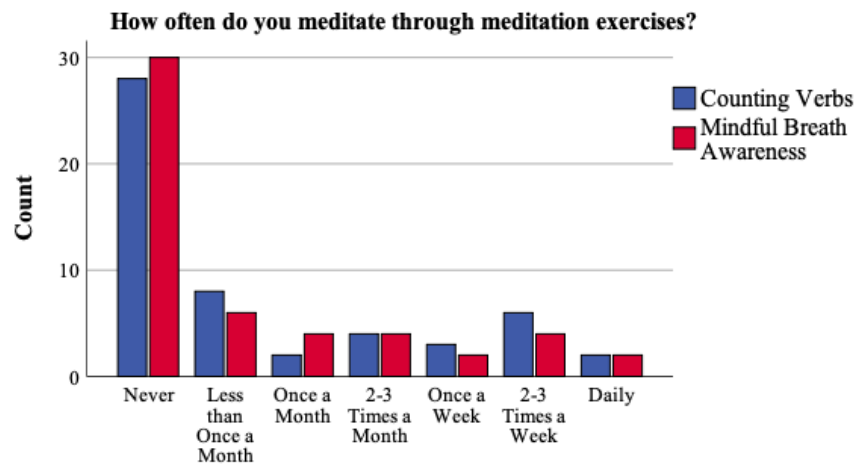


Figure 7: Meditation Practice

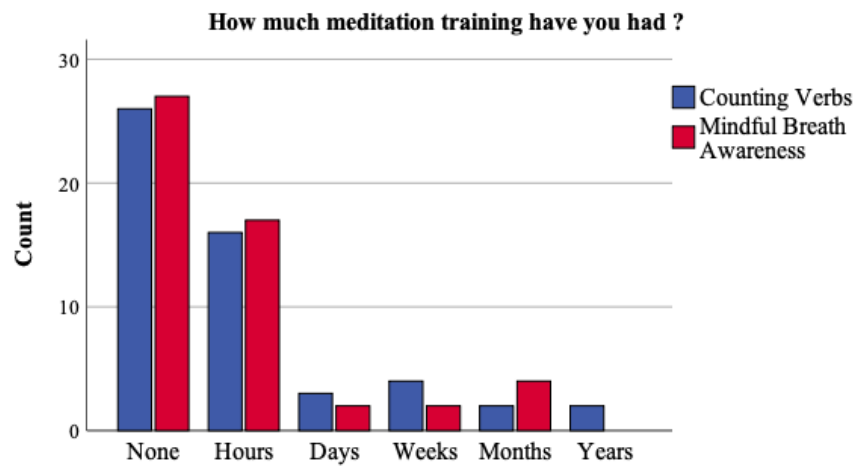


Figure 8: Meditation Experience

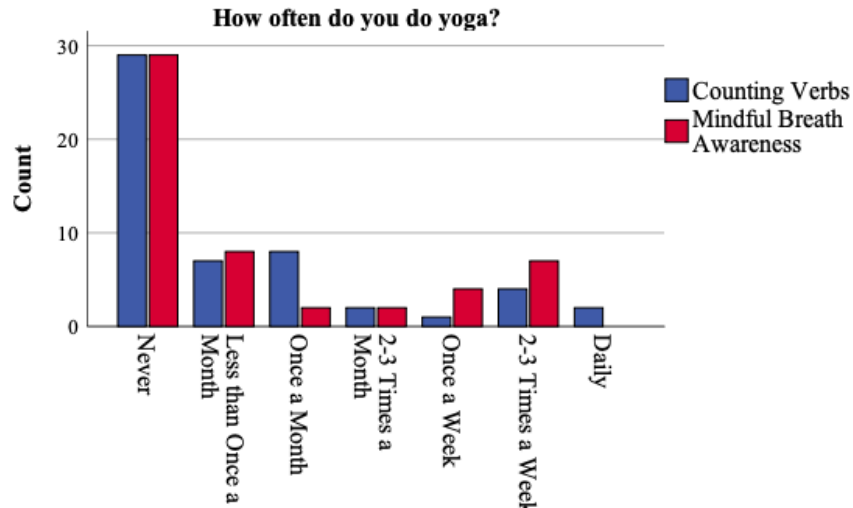


Figure 9: Yoga Practice



Figure 10: Yoga Experience

Appendix B: Audio Issues during the Recording

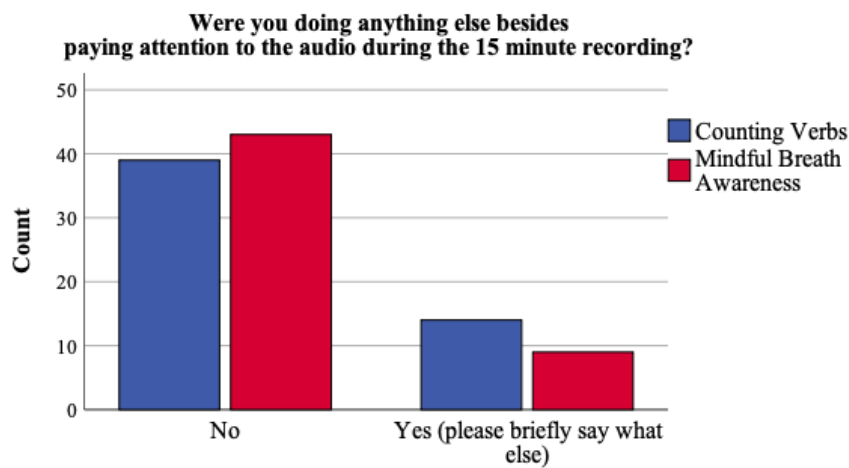


Figure 11: Distraction during Recording

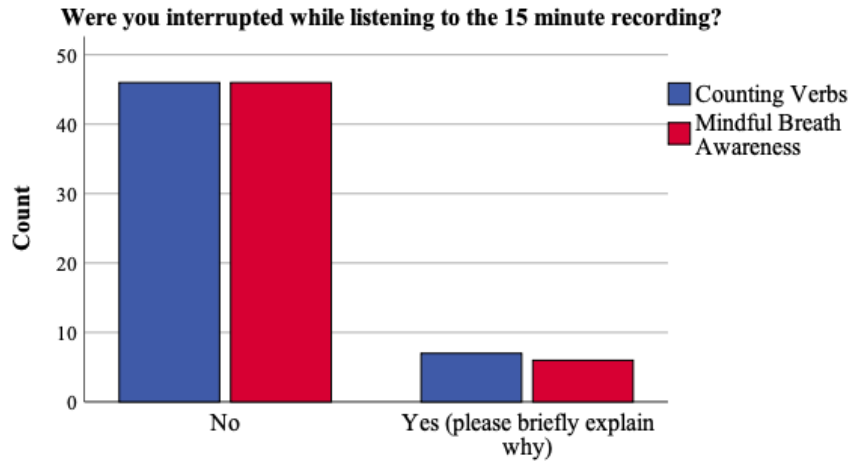


Figure 12: Interruption during Recording

Appendix C: Measures

State Mindfulness Attention Awareness Scale (Brown and Ryan 2003)

The following are some statements that describe how you feel right now. Please indicate the extent to which you feel this way with the scale provided (e.g. not at all, extremely, etc). Although some of the statements seem repetitive, please try your best to answer them.

Right now,

1. I find it difficult to stay focused on what's happening in the present.
2. I feel like I am rushing through activities without being really attentive to them.
3. I am doing things automatically, without being aware of what I'm doing.
4. I am preoccupied with the future or the past.
5. I find myself doing things without paying attention.

Toronto Mindfulness Scale (Lau et al. 2006)

The following are some statements that describe how you feel right now.

Please indicate the extent to which you agree with these statements. Although some of the statements seem repetitive, please try your best to answer them.

Right now,

1. I experience myself as separate from my changing thoughts and feelings.
2. I am more concerned with being open to my experiences than controlling or changing them.
3. I am curious about what I might learn about myself by taking notice of how I react to certain thoughts, feelings or sensations.
4. I experience my thoughts more as events in my mind than as a necessarily accurate reflection of the way things 'really' are.
5. I am curious to see what my mind is up to from moment to moment.
6. I am curious about each of the thoughts and feelings that I am having.
7. I am receptive to observing unpleasant thoughts and feelings without interfering with them.
8. I am more invested in just watching my experiences as they arise, than in figuring out what they could mean.
9. I approach each experience by trying to accept it, no matter whether it was pleasant or unpleasant.
10. I remained curious about the nature of each experience as it arises.
11. I am aware of my thoughts and feelings without overidentifying with them.
12. I am curious about my reactions to things.
13. I am curious about what I might learn about myself by just taking notice of what my attention gets drawn to.

Cognitive Reflection Test (Frederick 2005)

1. A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost? ____ \$.
(Correct response = 0.05 \$; Intuitive response = 0.1 \$)
2. If it takes 5 machines 5 min to make 5 widgets, how long would it take 100 machines to make 100 widgets? ____ min. (Correct response = 5 min; Intuitive response = 100 min)
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ____ days.
(Correct response = 47 days; Intuitive response = 24 days)

Cognitive Reflection Test (Thomson and Oppenheimer 2016)

1. If you're running a race and you pass the person in second place, what place are you in?
(Correct response: second; Intuitive response: first)
2. A farmer had 15 sheep and all but 8 died. How many are left?
(Correct response: 8; Intuitive response: 7)
3. Emily's father has three daughters. The first two are named April and May. What is the third daughter's name?
(Correct response: Emily; Intuitive response: June)
4. How many cubic feet of dirt are there in a hole that is 3' deep x 3' wide x 3' long?
(Correct response: none; Intuitive response: 27)

Task Focus Scale (Hafenbrack and Vohs 2018)

The following statements refer to your state of mind when doing the 7 Questions Cognitive Task. Read each item and indicate to which extent you agree with following statements.
When I was doing the 7 questions cognitive task,

1. my mind wandered away from the task at hand.
2. I was distracted from the task by unrelated thoughts.
3. I daydreamed about something else during the task.
4. I was able to focus completely on the task.
5. I was totally absorbed in the task.
6. I was totally immersed in the task.

Appendix D: Reading Speed Robustness Check

In the next page, you will read a short text that starts with the word "Grown-ups" and ends with the word "Prince". Once you have read it from start to finish, click ">>" to answer a short question about the text.

"Grown-ups love figures... When you tell them you've made a new friend they never ask you any questions about essential matters. They never say to you "What does his voice sound like? What games does he love best? Does he collect butterflies? " Instead they demand "How old is he? How much does he weigh? How much money does his father make? " Only from these figures do they think they have learned anything about him."

— Antoine de Saint-Exupéry, *The Little Prince* (Saint-Exupéry 2017)

According to the text in the previous page, what do grown-ups want to know about their children's friends?

1. They want to know if they collect butterflies.
2. They want to know if they like ice cream.
3. They want to know how much money the father makes.

Appendix E: Correlations with Time taken on CRT

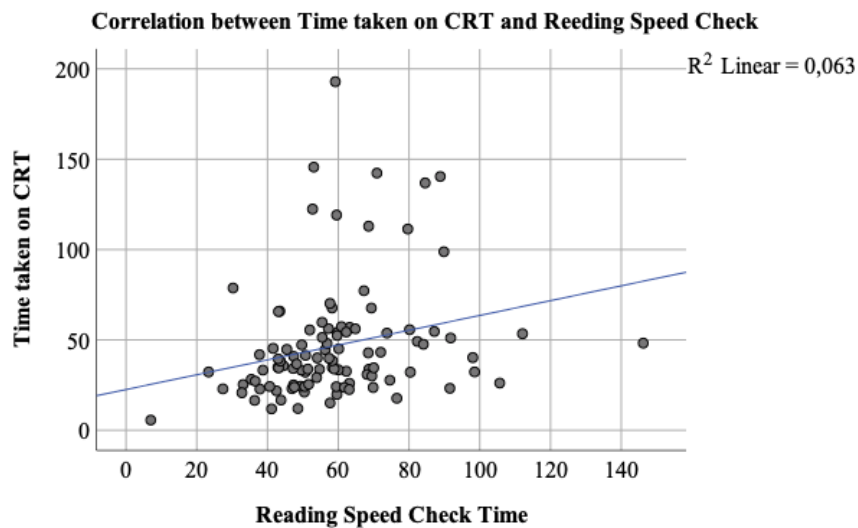


Figure 13: Correlation between Time taken on CRT and Familiar Tasks

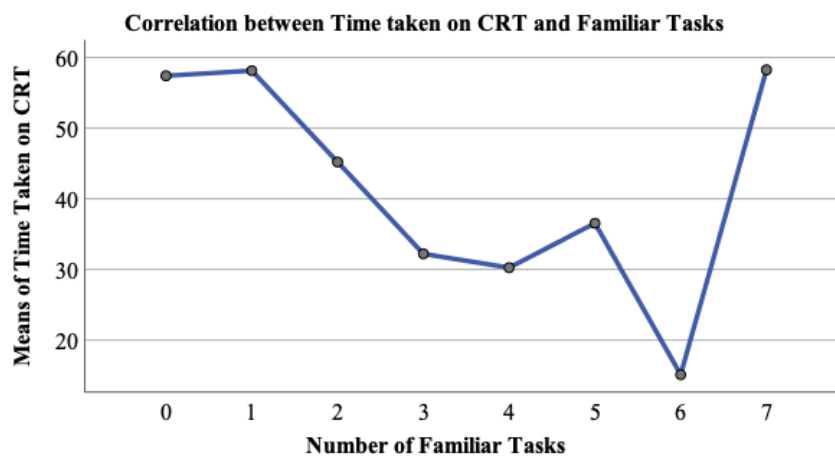


Figure 14: Correlation between Time taken on CRT and Familiar Tasks

Appendix F: Total Familiar Tasks

Table 2: Chi-Square Test on Familiar Tasks

<u>Chi-Square Tests</u>			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.63 ^a	7	.58
Likelihood Ratio	6.28	7	.51
Linear-by-Linear Association	.21	1	.65
N of Valid Cases	105		

a. 8 cells (50.0%) have expected count less than 5. The minimum expected count is .50.

Table 3: Overview Familiar Tasks between Conditions

<u>Overview Familiar Tasks between Conditions</u>				
		Counting Verbs	Mindfulness Condition	Total
Familiar Tasks	0	15	15	30
	1	9	10	19
	2	10	8	18
	3	15	9	24
	4	1	5	6
	5	2	3	5
	6	0	1	1
	7	1	1	2
Total		53	52	105

Appendix G: Effects of Condition on CRT Performance

Table 4: Effects of Condition on CRT Performance

<u>Tests of Between-Subjects Effects</u>					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	95.74 ^a	4	23.94	9.61	.00
Intercept	578.77	1	578.77	232.42	.00
Gender	24.66	1	24.66	9.90	.002
Familiar Tasks	36.66	1	36.66	14.72	.00
Condition	9.19	1	9.19	3.69	.06
Condition * Gender	4.95	1	4.95	1.99	.16
Error	249.023	100	2.490		
Total	2360.000	105			
Corrected Total	344.762	104			

a. R Squared = .278 (Adjusted R Squared = .249)

Appendix H: Mediation Effects of Task Engagement

Run MATRIX procedure:

***** PROCESS Procedure for SPSS Version 3.4.1 *****

Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2018). www.guilford.com/p/hayes3

Model : 4
Y : sumtasks (total task score)
X : COND_MFN (condition)
M1 : tfs (task focus)
M2 : totaltim (total time spent on tasks)

Covariates:
sumfamta gend

Sample
Size: 105

OUTCOME VARIABLE:
tfs

Model Summary	R	R-sq	MSE	F	df1	df2	p
	,1556	,0242	1,0002	,8355	3,0000	101,0000	,4775

Model	coeff	se	t	p	LLCI	ULCI
constant	3,6736	,4140	8,8740	,0000	2,8523	4,4948
COND_MFN	,0643	,1955	,3290	,7429	-,3235	,4522
sumfamta	,0932	,0614	1,5190	,1319	-,0285	,2149
gend	,0575	,2104	,2735	,7851	-,3598	,4748

OUTCOME VARIABLE:
totaltim

Model Summary	R	R-sq	MSE	F	df1	df2	p
	,3029	,0918	983,2389	3,4020	3,0000	101,0000	,0206

Model	coeff	se	t	p	LLCI	ULCI
constant	47,3812	12,9795	3,6505	,0004	21,6333	73,1291
COND_MFN	7,7014	6,1302	1,2563	,2119	-4,4592	19,8620
sumfamta	-5,0984	1,9239	-2,6500	,0093	-8,9149	-1,2819
gend	3,1763	6,5958	,4816	,6312	-9,9080	16,2605

OUTCOME VARIABLE:
sumtasks

Model Summary	R	R-sq	MSE	F	df1	df2	p
	,5887	,3466	2,2755	10,5015	5,0000	99,0000	,0000

Model	coeff	se	t	p	LLCI	ULCI
constant	3,5182	,8768	4,0125	,0001	1,7784	5,2580
COND_MFN	-,6193	,2975	-2,0817	,0399	-1,2095	-,0290
tfs	,4605	,1506	3,0573	,0029	,1616	,7593
totaltim	,0099	,0048	2,0547	,0425	,0003	,0194

sumfamta	,3619	,0965	3,7511	,0003	,1704	,5533
gend	-1,1227	,3178	-3,5323	,0006	-1,7533	-,4920

***** TOTAL EFFECT MODEL *****

OUTCOME VARIABLE:

sumtasks

Model Summary

R	R-sq	MSE	F	df1	df2	p
,5132	,2633	2,5146	12,0354	3,0000	101,0000	,0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	5,6774	,6564	8,6495	,0000	4,3753	6,9795
COND_MFN	-,5136	,3100	-1,6568	,1007	-1,1286	,1013
sumfamta	,3545	,0973	3,6431	,0004	,1614	,5475
gend	-1,0648	,3336	-3,1924	,0019	-1,7265	-,4031

***** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y *****

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI
-,5136	,3100	-1,6568	,1007	-1,1286	,1013

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI
-,6193	,2975	-2,0817	,0399	-1,2095	-,0290

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	,1056	,1185	-,1199	,3567
tfs	,0296	,0978	-,1719	,2265
totaltim	,0760	,0832	-,0391	,2801

***** ANALYSIS NOTES AND ERRORS *****

Level of confidence for all confidence intervals in output:

95,0000

Number of bootstrap samples for percentile bootstrap confidence intervals:

5000

NOTE: Variables names longer than eight characters can produce incorrect output.
Shorter variable names are recommended.

----- END MATRIX -----